Concentrated Animal Feeding Operations as a Source of Endocrine-Disrupting Chemicals and Their Management

Marc Mills
Environmental Engineer
U.S. EPA Office of Research and Development (ORD)/National Risk Management Research Laboratory (NRMRL)
(513) 569-7322
mills.marc@epa.gov

Authors: Marc A. Mills[1], Steve Hutchins[1], James Lazorchak[2], Gary Ankley[3]
[1]U.S. EPA ORD/NRMRL
[2]U.S. EPA ORD/National Exposure Research Laboratory (NERL)
[3]U.S. EPA ORD/National Health and Environmental Effects Research Laboratory (NHEERL)
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In the United States, there is an estimated 376,000 animal feed operations (AFOs), generating approximately 128 billion pounds of waste each year. A facility is an AFO if animals are stabled/confined or fed/maintained for 45 days or more within any 12-month period, and the facility does not produce any crops, vegetation, or forage growth. Concentrated animal feed operations (CAFOs) are the largest of these and are regulated under the Clean Water Act. CAFOs are generally considered to be operations with more than 1,000 animal units (AU). Endocrine-disrupting chemicals (EDCs) are known to be used or naturally produced by the three major categories of CAFOs. Cattle CAFOs use growth hormones, estrogens (estradiol, estradiol benzoate), and androgens (trenbolone acetate, testosterone propionate). Poultry CAFOs can contain natural hormones such as estradiol, estrone, and testosterone. Swine contain no added growth hormones, but produce natural hormones.

The NRMRL, NHEERL, and NERL have been developing analytical and biological tools to assess the extent, exposure, and effects of these estrogens in ground and surface waters. The NHEERL has developed an analytical chemistry method for 17α- and 17β-trenbolone in cattle feedlot discharge and in river water and has measured *in vitro* androgenic activity of the discharge using CV-1 cells that had been transiently cotransfected with human androgen receptor and reporter gene constructs. The NERL has applied a vitellogenin gene expression assay to trenbolone in cattle CAFO discharges. The NRMRL has been working on developing GC/MS/MS and LC/MS/MS protocols for analyzing swine lagoon effluent and groundwater for estrogens and estrogen conjugates at environmentally relevant levels (ng/L). The NRMRL has been applying these methods to determine whether swine CAFOs contribute estrogens to ground and surface waters at land application sites and downstream of CAFO facilities. In addition, the NERL is collaborating with the US Geological Survey and the State of West Virginia to look at potential linkages of poultry wastes to high incidences of Ova-testis in male small mouth bass.

Currently, the ORD is developing analytical and biological approaches to measure and detect EDCs in ground and surface waters and assess the potential exposures to aquatic life. With these approaches, various field sites will be selected where these tools can be used to further assess the potential exposure and effects of EDCs from CAFOs on ground and surface water communities.

This information will then be provided to the Regions and program offices for decisions on best management practices for controlling EDCs.